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LISTS OF SPECIES

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Ichthyofauna of Ranganadi River in Lakhimpur, Assam, India

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Abstract: The ichthyofauna of the Ranganadi River, a tributary of the Brahmaputra River in Lakhimpur district, Assam, India, has not been documented so far. To fill this knowledge gap, samples were taken in the Ranganadi River from April 2012 to March 2014, which included 61 species of fishes belonging to six orders, 17 families and 45 genera. One of these species is Endangered, two are as Vulnerable, and six are Near Threatened according to the International Union for the Conservation of Nature. This study will help support the conservation of fish diversity in the Ranganadi River of Assam and the surrounding ecosystems.

Key words: fish fauna; Ranganadi River basin; Lakhimpur

INTRODUCTION

India ranks ninth in terms of freshwater mega biodiversity, with the northeast region recognized as a global hotspot of freshwater fish species (Kottelat and Whitten 1996; Kansal and Arora 2012). Assam, a part of the Indo-Burma biodiversity hotspot, has many torrential streams, which harbour an adapted ichthyofauna (Sen 1999).

Studies on the diversity and conservation of fish in aquatic ecosystems have always attracted the attention of various fishery researchers (Kar et al. 2006). Aquatic ecosystem provides multiple services in terms of supporting aquatic diversity, as well as climate and flood control (Meyer et al. 2007; Tariq et al. 2014). Bagra et al. (2009) surveyed a total of 35 streams and rivers in Arunachal Pradesh including the Subansiri, Ranganadi and upper stretch of the Dikrong and recorded a total of 213 fish species of which 31 species were from Ranganadi in Kimin (27°21′01″ N, 093°57′11″ E) and Yazali (27°23′04″ N, 093°45′28″ E) area of Papum Pare and Lower Subansiri districts. Sampling of the available ichthyofauna in wetlands of Lakhimpur district was done by Bakalial et al. (2014), who surveyed lower Subansiri River drainage and reported 204 species belonging to 34 families. Hazarika (2013) reported 42 species belonging to 19 families from Satajan wetland of Lakhimpur district.

The present study, geographically confined to the Lakhimpur district, state of Assam, is the first report on documentation of the available ichthyofauna.

MATERIALS AND METHODS

Study site

Lakhimpur district (26°48′ N to 27°53′ N, 093°42′ E to 094°20′ E) encompasses an area of 2,977 km^2. The district is bordered by Siang and Papumpare districts of Arunachal Pradesh in the north, Dhemaji district in the east, the Majuli subdivision of Jorhat district in the south, and Gohpur subdivision of Sonitpur district in the west. The four main rivers are the Brahmaputra, Subansiri, Ranganadi and Dikrong.

Ranganadi River (27°11′11″ N, 094°03′54″ E at its entry into the state of Assam), a northern tributary of the Subansiri, originates from Dafla hills of Arunachal Pradesh at an altitude of 3,400 m, flows through the Lesser Himalaya, Outer Himalaya and the valley of the River Brahmaputra (Figure 1). The maximum and minimum discharge of the Ranganadi River ranges between 900 to 130 m^3/s (unpublished data, Water Resource Department, Lakhimpur District, Government of Assam 2014). The Ranganadi River enters Assam near Johing (27°20′38.96″ N, 094°01′56.23″ E), traverses 60 km and joins Subansiri River in Pokoniaghat (27°01′27.72″ N 94°03′05″ E), in Lakhimpur district of Assam.

Data collection

Fieldwork was done monthly in the lower stretch of the Ranganadi River (27°18′26.7″ N, 094°01′48.1″ E) during April 2012 to March 2014. The fishes were first preserved in 10% and then transferred to 6% formaldehyde solution in the laboratory. Morphometric measurements for identification of species were done with vernier calliper (Mitutoyo) to the nearest 0.05 mm soon after preservation to avoid shrinkage. For molecular analysis, tissue samples were collected and

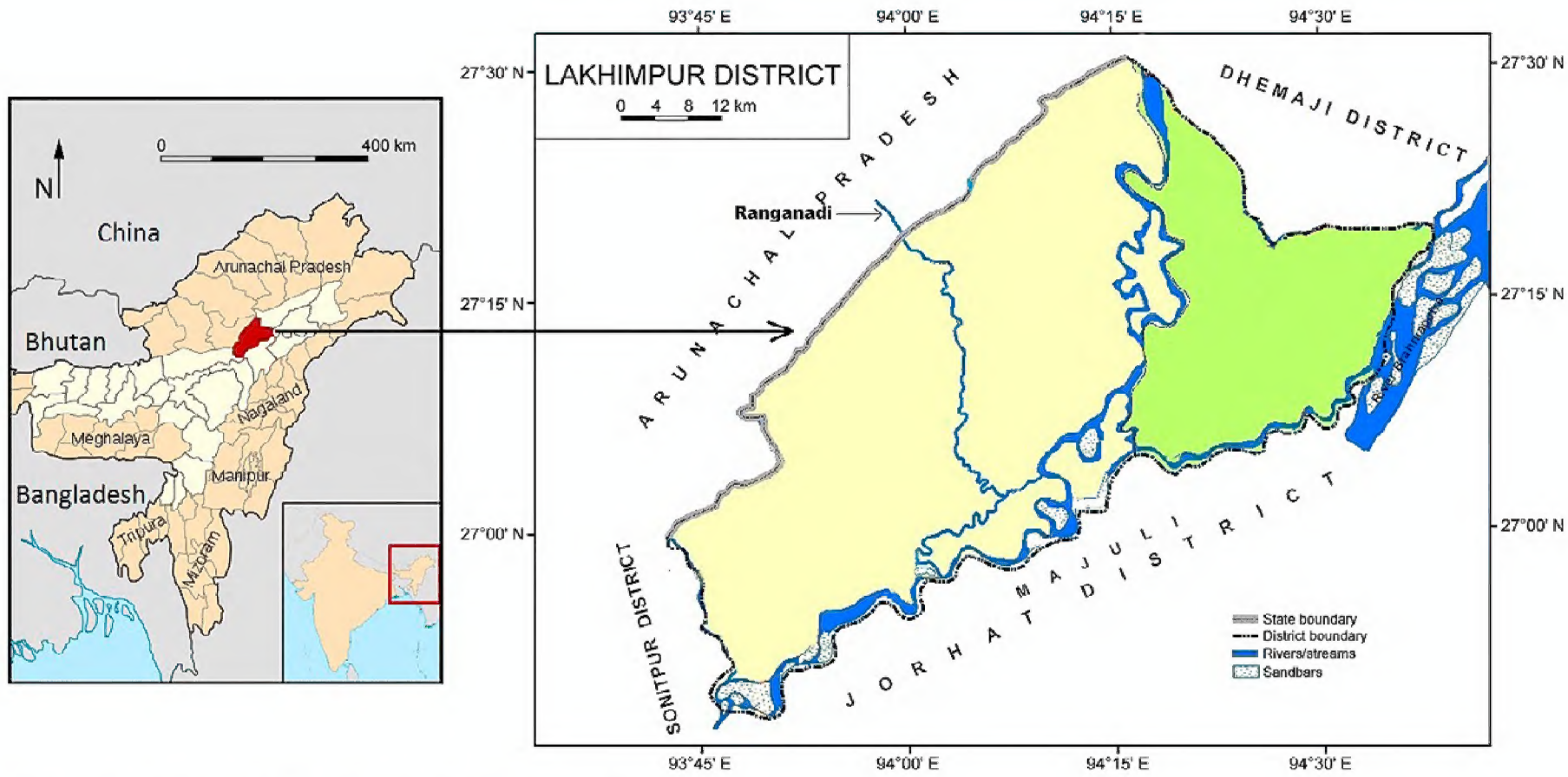

Figure 1. Map of Lakhimpur district showing the Ranganadi River.

preserved in ethanol for some of the voucher specimens before preservation in formaldehyde.

Fishes were identified with the aid of the literature (Jayaram 1999; Nath and Dey 2000; Talwar and Jhingran 1991; Vishwanath et al. 2007). Nomenclature was updated following Froese and Pauly (2015) and Eschmeyer and Fong (2015). The current conservation status of fish species was verified (IUCN 2014). All samples were preserved in the Biodiversity Museum, Institute of Advanced Study in Science and Technology (Guwahati, Assam, India) and given voucher numbers (IASST F 120 to IASST F 180; Appendix, Table A1).

RESULTS

In the present study, 61 species, belonging to six orders, 19 families and 44 genera were recorded (Figure 2). One species is assessed as Endangered, six species are Near Threatened, two species are Vulnerable, and the other 46 species are Least Concern according the International Union for the Conservation of Nature (IUCN 2014). One additional species is Not Evaluated and four species are Data Deficient (IUCN 2014).

Cyprinidae is the most species rich family, with 20 species belonging to 16 genera. Next in species richness are Sisoridae with 6 spp., 3 genera), Cobitidae (5 spp., 3 genera), Bagridae (4 spp., 3 genera), Nemacheilidae (3 spp., 3 genera), Erethistidae (3 spp., 2 genera), Badidae and Psilorhynchidae (each with 3 spp., 1 genus), Ambassidae (2 spp., 2 genera), Amblycipitidae and Olyridae (each with 2 spp., 1 genus), Balitoridae, Schilbeidae, Siluridae, Gobiidae, Channidae, Anguillidae, Mastacembelidae, Belonidae (each with 1 sp.).

Altogether, 32.8% of the fish species recorded belong to the family Cyprinidae, 9.8% to Sisoridae, 8.2% to Cobitidae, 6.6% to Bagridae, 4.9% to Erethistidae, Badidae, Psilorhynchidae and Nemacheilidae, 3.3% to Olyridae, Ambassidae and Amblycipitidae, 1.6% to Balitoridae, Gobiidae, Mastacembelidae, Channidae, Belonidae, Anguillidae, Schilbeidae and Siluridae. Endangered fish (*Amblyceps arunachalensis*), Vulnerable fishes (*Devario assamensis* and *Botia rostrata*), and Near Threatened fishes (*Balitora brucei, Tor tor*, *Aborichthys kempi, Glyptothorax striatus* and *Anguilla bengalensis*) were also recorded during the survey. Eleven of the 61 recorded species are coldwater fishes, seven species are warm–cold water fishes, 21 species are warmwater fishes and the other 21 species were not categorised as per Kapoor et al. (2002).

Ojha and Singh (1992) characterized the fish species from hill streams as inhabitants of swift, turbulent and cascading hyperoxic water, and these species exhibit a number of adaptive modifications. The ichthyofauna is composed of 27 "hill stream species" and 29 riverine species (Froese and Pauly 2015; Ojha and Singh 1992). Our study also recorded five migratory species (Froese and Pauly 2015) (Table 1).

Species such as *Badis badis, Barilius bendelisis*, *Acanthocobitis botia, Chanda nama* were more abundant (*B.bendelisis* = 110/400, *B.badis* = 68/400, *A. botia* = 57/400, *C. nama* = 42/400). However, only one specimen for *Tor tor, Anguilla bengalensis, Devario assamensis* and *Mastacembelus armatus* were captured. *Badis badis* and *Chanda nama* could be collected only in post-monsoon season and at the beginning of the winter.

DISCUSSION

Anthropogenic activities such as the construction of dams for a hydroelectric power project in the upper or middle stretches of rivers may influence hydrology of dammed rivers as well as the efficiency of the channel downstream of the dam site (Dynesius and Nilsson 1994; Baxter 1997; Batalla et al. 2004). Downstream,

Table 1. List of fishes from the Ranganadi River. EN = Endangered, VU = Vulnerable, NE = Not Evaluated, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, H = Hill Stream, R = Riverine and MF = Migratory Fish.

Order	Species	IUCN Red List status	Habitat		
			H	R	M.F
Cypriniformes	*Barilius bendelisis* (Hamilton, 1807)	LC	–	–	+
	Barilius vagra (Hamilton, 1822)	LC	+	–	–
	Barilius shacra (Hamilton, 1822)	LC	–	+	–
	Danio dangila (Hamilton, 1822)	LC	+	–	–
	Cabdio morar (Hamilton, 1822)	LC	–	+	–
	Lepidocephalichthys guntea (Hamilton, 1822)	LC	–	+	–
	Chagunius chagunio (Hamilton, 1822)	LC	+	–	–
	Garra gotyla (Gray, 1830)	LC	+	–	–
	Psilorhynchus balitora (Hamilton, 1822)	LC	+	–	–
	Acanthocobitis botia (Hamilton, 1822)	LC	–	+	–
	Aborichthys kempi Chaudhuri, 1913	NT	+	–	–
	Rasbora daniconius (Hamilton, 1822)	LC	–	–	+
	Schistura tirapensis Kottelat 1990	LC	+	–	–
	Balitora brucei Gray, 1830	NT	+	–	–
	Crossocheilus latius (Hamilton, 1822)	LC	+	–	–
	Puntius guganio (Hamilton, 1822)	LC	–	+	–
	Pethia ticto (Hamilton, 1822)	LC	–	+	–
	Aspidoparia jaya (Hamilton, 1822)*	LC	–	+	–
	Danio rerio (Hamilton, 1822)	LC	–	+	–
	Labeo dyocheilus (McClelland, 1839)	LC	–	–	+
	Garra annandalei Hora, 1921	LC	+	–	–
	Tor tor (Hamilton, 1822)	NT	–	–	+
	Canthophrys gongota (Hamilton, 1822)	LC	–	+	–
	Botia almorhae Gray, 1831	LC	+	–	–
	B. rostrata Günther, 1868	VU	+	–	–
	B. histrionica Blyth, 1860	LC	+	–	–
	Osteobrama cotio (Hamilton, 1822)	LC	–	+	–
	Devario assamensis (Barman 1984)	VU	–	+	–
	Psilorhynchus sucatio (Hamilton, 1822)	LC	+	–	–
	Laubuka laubuca (Hamilton, 1822)	LC	–	+	–
	Cirrhinus reba (Hamilton,1822)	LC	–	+	–
	Psilorhynchus arunachalensis (Hamilton, 1822)	DD	+	–	–
Siluriformes	*Amblyceps* sp.	—	+	–	–
	Amblyceps arunchalensis Nath & Dey,1889	EN	+	–	–
	Olyra kempi Chaudhuri, 1912**	LC	+	–	–
	Mystus dibrugarensis (Chaudhuri 1913)	LC	–	+	–
	Eutropiichthys vacha (Hamilton, 1822)	LC	–	–	+
	Gagata cenia (Hamilton, 1822)	LC	–	+	–
	Batasio tengana (Hamilton, 1822)	LC	–	+	–
	Mystus vittatus (Bloch, 1794)	LC	–	+	–
	Erethistoides montana Hora,1950	DD	+	–	–
	Olyra longicaudata McClelland, 1842	LC	+	–	–
	Wallago attu (Bloch & Schneider, 1801)	NT	–	+	–
	Sperata seenghala (Skyes,1939)	LC	–	+	–
	Glyptothorax cavia (Hamilton, 1822)	LC	+	–	–
	G. striatus (McClelland, 1842)	NT	+	–	–
	Pseudolaguvia ferula Ng, 2006	DD	+	–	–
	Pseudolaguvia shawi (Hora, 1921)	LC	+	–	–
	Nangra assamensis Sen & Biswas, 1994	LC	–	+	–
	Glyptothorax telchitta (Hamilton,1822)	LC	+	–	–
	Glyptothorax trilineatus Blyth, 1860	LC	+	–	–
Perciformes	*Parambassis baculis* Hamilton, 1822	LC	–	+	–
	Chanda nama Hamilton, 1822	LC	–	+	–
	Badis badis (Hamilton, 1822)	LC	–	+	–
	Badis singenensis Geetakumari & Kadu, 2011	NE	–	+	–
	Badis kanabos Kullander & Britz, 2002	DD	–	+	–
	Glossogobius giuris (Hamilton, 1822)	LC	–	–	+
	Channa gachua (Hamilton, 1822)	LC	+	–	–
Anguilliformes	*Anguilla bengalensis* (Gray, 1831)	NT	–	–	+
Synbranchiformes	*Mastacembelus armatus* (Lacepède, 1800)	LC	–	+	–
Beloniformes	*Xenentodon cancila* (Hamilton, 1822)	LC	–	+	–

* In Eschmeyer and Fong (2015), *Aspidoparia jaya* is mentioned as *Cabdio jaya.*
** *Olyra kempi* is mentioned as the synonym for *Olyra longicaudata.*

Figure 2. Indigenous fishes collected from April 2012 to March 2014 in the Ranganadi River. **A**: *Anguilla bengalensis*. **B**: *Mastacembelus armatus*. **C**: *Parambassis baculis*. **D**: *Amblyceps arunchalensis*. **E**: *Glyptothorax telchiita*. **F**: *Glyptothorax trilineatus*. **G**: *Olyra kempi*. **H**: *Tor tor*. **I**: *Canthophrys gongota*.

the Ranganadi River experiences the effects of having the North Eastern Electric Power Corporation (NEEPCO) dam, with a capacity of 405 MW (27°20′03″ N, 093°49′00″ E) at Yazali in Lower Subansiri district, Arunachal Pradesh. The modified river flow downstream of the dam have a variety of negative effects on the fish fauna, including loss of stimuli for migration, loss of routes for migration and spawning grounds, decrease in the survival of eggs and juveniles, and diminished food production (Kansal and Arora 2012). Besides these known impacts, the presence of high species diversity reduces disease problems and encourages recovery from disturbances (Kar et al. 2006). The NEEPCO dam might have affected the fishes and eventually the diversity

of the fishes in the lower stretch the Ranganadi River. However, 61 fish species were recorded in the Ranganadi River within Assam, including a number of threatened species.

The Ranganadi River enters Assam on a steep gradient and gradually becomes a slow flowing river before joining the Subansiri River at Pokoniaghat. Presence of *A. arunchalensis*, *A. bengalensis*, *A. kempi*, *B. brucei*, *B. rostrata*, *D. assamensis*, *G. striatus*, *T. tor* and *Wallago attu* shows the presence of many different microhabitats within the river, which are important for feeding and breeding. These features could also help increase the ichthyofaunal diversity in the Ranganadi River.

Fishes such as *Tor tor*, *Labeo dyocheilus, Barilius bendelisis, Anguilla bengalensis* and *Glossogobius giuris* can migrate long distances in trans-Himalayan rivers (Talwar and Jhingran, 1991; Das and Bordoloi 1997; Hill and Hill 1994; Menon 1999). Depending on the water quality and environmental factors such as temperature and rainfall, these fish species migrate to the large rivers for feeding or breeding.

Fish ladders are generally believed to re-establish connectivity between critical habitats for migratory species and reduce the anthropogenic stress on the fish fauna. However, to be useful, fish ladders must assure both upward and downward movements of fishes. It is imperative to maintain a minimum water flow, especially during the winter, when the contribution of the rainfall greatly decreases (Agostinho et al. 2007).

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APPENDIX

Table A1. Voucher numbers of the samples deposited in the museum of Institute of Advanced Study in Science and Technology (IASST).

Species	Voucher No.	Species	Voucher No.	Species	Voucher No.
Barilius bendelisis	IASST F 120	*Canthophrys gongota*	IASST F 141	*Pseudolaguvia ferula*	IASST F 162
B. vagra	IASST F 121	*Botia almorhae*	IASST F 142	*P. seudolaguvia shawi*	IASST F 163
B. shacra	IASST F 122	*Botia rostrata*	IASST F 143	*Nangra assamensis*	IASST F 164
Danio dangila	IASST F 123	*B. histrionica*	IASST F 144	*Glyptothorax telchitta*	IASST F 165
Cabdio morar	IASST F 124	*Osteobrama cotio cotio*	IASST F 145	*G. trilineatus*	IASST F 166
Lepidocephalichthys guntea	IASST F 125	*Devario assamensis*	IASST F 146	*Parambassis baculis*	IASST F 167
Chagunius chagunio	IASST F 126	*Psilorhynchus sucatio*	IASST F 147	*Chanda nama*	IASST F 168
Garra gotyla gotyla	IASST F 127	*Laubuka laubuca*	IASST F 148	*Badis badis*	IASST F 169
Psilorhynchus balitora	IASST F 128	*Cirrhinus reba*	IASST F 149	*Badis singenensis*	IASST F 170
Acanthocobitis botia	IASST F 129	*Amblyceps sp.*	IASST F 150	*Badis kanabos*	IASST F 171
Aborichthys kempi	IASST F 130	*Amblyceps arunachalensis*	IASST F 151	*Glossogobius giuris*	IASST F 172
Schistura tirapensis	IASST F 131	*Olyra kempi*	IASST F 152	*Channa gachua*	IASST F 173
Balitora brucei	IASST F 132	*Mystus dibrugarensis*	IASST F 153	*Anguilla bengalensis*	IASST F 174
Crossocheilus latius	IASST F 133	*Gagata cenia*	IASST F 154	*Mastacembelus armatus*	IASST F 175
Puntius guganio	IASST F 134	*Batasio tengana*	IASST F 155	*Xenentodon cancila*	IASST F 176
Pethia ticto	IASST F 135	*Mystus vittatus*	IASST F 156	*Psilorhynchus arunachalensis*	IASST F 177
Aspidoparia jaya	IASST F 136	*Erethistoides montana*	IASST F 157	*Glyptothorax striatus*	IASST F 178
Danio rerio	IASST F 137	*Olyra longicaudata*	IASST F 158	*Eutropiichthys vacha*	IASST F 179
Labeo dyocheilus	IASST F 138	*Wallago attu*	IASST F 159	*Rasbora daniconius*	IASST F 180
Garra annandalei	IASST F 139	*Sperata seenghala*	IASST F 160		
Tor tor	IASST F 140	*Glyptothorax cavia*	IASST F 161		